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SPECIFICATION

accompanying

Application for Grant of U.S. Letters Patent

TITLE: SYSTEM AND METHOD FOR WIRELESS CONTENT SWITCH

RELATED APPLICATIONS

This application claims priority to U.S. Provisional Patent Application serial number 60/192,169, entitled "Web-based Device Agnostic Middleware to Enable Information Access by Wireline and Wireless Devices," filed March 27, 2000, which is commonly owned and assigned with the present application.

FIELD OF THE INVENTION

The present invention pertains to the field of wireline wireless data transmission. More specifically, the invention relates to a system and method for a wireless content switch that allows content servers to provide data

to wireless devices without requiring special adaptation to different wireless network protocols for reliable transport, policy, group communications, quality of service, and security.

BACKGROUND

Systems for transmitting wireless data are known in the art. These systems typically allow a user of a wireless device, such as a personal digital assistant (PDA), a web-enabled cell phone (such as one that is configured to receive wireless application protocol (WAP) data format messages), a text pager, a laptop or a desktop computer, or other suitable wireless devices to receive text messages, hypertext markup language (HTML) data, wireless markup language (WML) data, or other suitable forms of data. Such wireless devices can display the data to a user, thus allowing the user to receive data over the wireless device. Users can also receive E-mail messages and files.

Although such wireless data capability provides users with a certain level of service, there are many inefficiencies with the existing configuration for provision of wireless data. One of the most significant inefficienccies is that users cannot access standardized information or services over the World Wide Web or Internet. In order to provide information to a user of a wireless device from a server that is configured to provide data over the Internet, the data must be configured and adapted for use with wireless devices. The practice of converting a web page that is accessible through a standard general purpose computing platform operating web browser software application into data that can be accessed from a wireless device is referred to as "web clipping," where only the most pertinent data for a given web page is extracted for provision to the wireless device. Web clipping requires a user to manually modify the web page data so that it can be provided to a wireless device. Likewise, application data is modified to fit the user device. Thus, in a business environment, it is

typically necessary to provide all employees of an organization with the same type of device so as to ensure that data access at such devices will be supported. Likewise, if customers require access to data but do not have such devices, then support of such customers will not be provided.

There are other problems with providing data to wireless devices that prevent them from being fully utilized. For example, because of the large number of different wireless-enabled devices, it is often impossible to configure an application to provide data to multiple users simultaneously that are operating different devices. It is also not possible to prioritize the data for applications, individual users, and organizational policies for various wireless networks. In addition, due to the inherent nature of wireless networks, a user can be rendered unavailable for a period of time, such as if the user enters an area in which wireless service is not provided or switches off the wireless device. Therefore, it is not possible to provide reliable transport of information with known systems and methods for providing data in a wireless environment.

SUMMARY OF THE INVENTION

In accordance with the present invention, a system and method for a wireless content switch are provided that overcome known problems with providing wireless data access.

In particular, a system and method for a wireless content switch are provided that allow data to be provided to wireless devices over various networks to support web clipping and application data, and in a manner that allows different types of devices to simultaneously receive the data.

In accordance with an exemplary embodiment of the present invention, a wireless content switch is provided. The wireless content switch includes a content adapter that receives content data from one or more content servers, such as data in an XML format. An access adapter connected to the content adapter receives the content data and converts the format of the content data into a wireless device format, such as for cell phones, personal digital assistants, pagers, or Internet appliances. A transport module connected to the access adapter receives the content data in the wireless device format, appends address data to the content data and transmits the content data and address data over a communications medium.

The present invention provides many important technical advantages. One important technical advantage of the present invention is a system and method for a wireless content switch that allows data from a content server to be configured for provision to a wireless device dynamically for a message session, such that web clipping and other forms of device-specific manual data manipulation is supported. The present invention also allows multiple device formats to be used, such that data can be transmitted to different devices

in parallel, thus enabling employees, business partners, and customers to access data from diverse wireless devices.

Those skilled in the art will further appreciate the advantages and superior features of the invention together with other important aspects thereof on reading the detailed description that follows in conjunction with the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a diagram of a system for providing wireless data in accordance with an exemplary embodiment of the present invention;

FIGURE 2 is a diagram of a system for providing service management for network functionality in accordance with an exemplary embodiment of the present invention;

FIGURE 3 is a diagram of a system for providing transport module functionality in accordance with an exemplary embodiment of the present invention;

FIGURE 4 is a diagram of a system for providing access adapter functionality in accordance with an exemplary embodiment of the present invention;

FIGURE 5 is a flowchart of a method for allowing a user to receive information through a wireless device in accordance with an exemplary embodiment of the present invention;

FIGURE 6 is a flowchart of a method for providing information push data in accordance with an exemplary embodiment of present invention;

FIGURE 7 is a diagram of a system for providing data in a wireless environment in accordance with an exemplary embodiment of the present invention;

FIGURE 8 is a flowchart of a method for implementing an information pull process in conjunction with a wireless content switch, in accordance with an exemplary embodiment of the present invention;

FIGURE 9 is a flowchart of a method for providing management functionality in accordance with an exemplary embodiment of the present invention;

FIGURE 10 is a flowchart of a method for escalating messaging functions in accordance with an exemplary embodiment of the present invention;

FIGURE 11 is a flowchart of a method for dynamic addressing and address management in accordance with an exemplary embodiment of the present invention; and

FIGURE 12 is a flowchart of a method for controlling quality of service and providing reliable transport in a wireless environment in accordance with an exemplary embodiment of the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

In the description that follows, like parts are marked throughout the specification and drawings with the same reference numerals, respectively. The drawing figures might not be to scale, and certain components can be shown in generalized or schematic form and identified by commercial designations in the interest of clarity and conciseness.

FIGURE 1 is a diagram of a system 100 for providing wireless data in accordance with an exemplary embodiment of the present invention. System 100 provides wireless data to devices using a wireless content switch 102, such that data can be provided from a plurality of data sources to a plurality of different wireless devices, without manual modification of the data to meet service requirements for specific devices or types of wireless data service.

Wireless content switch 102 can be implemented in hardware, software, or a suitable combination of hardware and software, and can be one or more software systems operating on a general purpose server platform. As used herein, a software system can include one or more objects, agents, threads, subroutines, lines of code, two or more lines of code or other suitable software structures operating in two or more different software applications, or other suitable software architectures, and can operate on two or more different processors. In one exemplary embodiment, a software system can be one or more lines of code or other suitable software structures operating in a general purpose software application such as an operating system, and one or more lines of code or other suitable software structures operating in a specific purpose software application.

Wireless content switch 102 is coupled to content servers 104a and 104b through communications medium 122. As

used herein, the term "couple" and its cognate terms such as "couples" and "coupled" can include a physical connection (such as through a copper conductor, a fiber optic conductor, or a wireless data channel), a logical connection (such as through logical devices of a semiconducting circuit), a virtual connection (such as through randomly assigned data memory locations of a data memory device), other suitable connections, or a suitable combination of such connections. In one exemplary embodiment, systems and components are coupled to other systems and components through intervening systems and components, such as through an operating system on a general purpose server platform. Likewise, systems and components can be coupled to other systems and components through a wireless data transmission medium, a wireline data transmission medium, other data transmission media, or a suitable combination of data transmission media.

Wireless content switch 102 is also coupled to communications medium 112, which can be the Internet, a local area network, a wide area network, a wireless network, a virtual private network, routed data, the public switched telephone network, or other suitable communications media that allow wireless content switch 102 to provide wireless data to wireless data communications system 114. Likewise, a general purpose computing platform 106 can also receive data from wireless content switch 102, and can be configured to receive the data in the form of standardized data structures, such as extensible markup language (*.XML) data or *.HTML data. Wireless data communications system 114 is coupled to wireless devices 108 and 110, which can be a web-enabled cell phone, a personal digital assistant, a pager, a laptop computer, Internet appliances, or other suitable wireless or wireline devices.

Communications medium 122 can be the Internet, a local area network, a wide area network, a wireless network, or other suitable networks. Likewise, communications medium 122 can be an internal bus where content servers 104a and 104b are also used to operate the software systems of wireless content switch 102.

Wireless content switch 102 includes content adapter 116, access adapter 118, and transport module 120, each of which can be implemented in hardware, software, or a suitable combination of hardware and software, and which can be one or more software system operating on a general purpose server platform. Content adapter 116 interfaces with content servers 104a and 104b to provide data in one or more standardized data formats for provision over a wireless network to wireless devices, a physical network to general purpose computing platforms, or other suitable communications media and devices. In one exemplary embodiment, content adapter 116 includes a plurality of content adapters with XML/XSL and other related standard based interfaces that have been configured to receive predetermined data structures from a content server. Extensible markup language allows a document to be composed of a series of entities, where each entity can contain one or more logical elements and each element can have certain attributes or properties that describe the way in which it is to be processed. Each document can be provided with a document type definition (DTD) that declares each of the permitted entities, elements, and attributes, and the relationships between them. Likewise, the DTD can also be undefined, where the permitted entities, elements, attributes, and relationships are imposed or inferred at the receiving system. Content adapter 116 thus receives and processes XML to allow the data contained

within XML documents to be processed and configured to provision to wireless devices.

Access adapter 118 is coupled to content adapter 116 and adapts the content specific device characteristics and underlying protocols carrying information to the device for each wireless data stream by adjusting it to the access device characteristics, including the display. Access adapter 118 can use extensible style sheet language (XSL) or other suitable standard formats for describing the content specific display characteristics in a style sheet. The device capabilities of each type of supported device, including the form factor, can be defined in another style sheet developed and maintained by the operator of wireless content switch 102. The device style sheets do not change with different content information. Therefore, the device style sheet data contained by access adapter 118 for a plurality of wireless devices allows the data received from content servers 104a and 104b to be provided in a suitable style sheet for those wireless devices.

Content adapter 116 interfaces with the source of information at the transport or session layer. Content adapter 116 can be bypassed if the content is binary data, such as image or audio data, or if the data has already been formatted for the end device display characteristics. If the information is in any other format and needs adaptation to the characteristics of the display of the user device, the content adapter can convert the content description to the XML vocabulary data or to other suitable data formats before sending it to the access adapter 118. Content adapter 116 can also support one or more different presentation formats and lower Open Systems Interconnect (OSI) layers, such as by interworking Internet protocols for software applications in

vertical markets, such as finance, healthcare, telecommunications network management, and other suitable markets.

Transport module 120 is coupled to access adapter 118, and communications medium 112. Transport module 120 can format data packets received from access adapter 118 in a suitable transport protocol format for transmission to wireless devices 108 and 110 or general purpose computing platform 106. Likewise, transport module 120 can receive incoming data packets over wireless data communications system 114 from wireless devices 108 and 110, and can perform additional analysis of the data packets so as to extract user identification and preference data, application identification data, device address data, and other suitable data. In this manner, transport module 120 can be used to transmit data from access adapter 118 to one or more wireless devices 108 and 110 over different protocols, and to receive data from such devices and process the data for transmission to access adapter 118.

Content servers 104a and 104b provide data services to operators of wireless devices 108 and 110. In one exemplary embodiment, content servers 104a and 104b are multiple servers operating at a single location in conjunction with load balance switches, but could also be two separate content servers at different physical locations. Likewise, content servers 104a and 104b can be physically located with wireless content switch 102, such that the systems of wireless content switch 102 operate on one or both of content servers 104a and 104b.

In operation, wireless content switch 102 provides switching functionality to allow wireless devices 108 and 110 to access data services and data stored on content

servers 104a and 104b. Wireless content switch 102 can also process data requests and data messages for or from non-wireless devices, such as general purpose computing platform 106. Wireless content switch 102 uses a content adapter 116 to interface with content servers 104a and 104b, such that the data and services provided by the servers is converted into a standardized format. Access adapter 118 then performs message context and device context processing of the data, and the processed data is provided to transport module 120 for transmission to devices 108 and 110 to each user. Transport module 120 can further label or tag and monitor the quality of service provided to such devices, can transmit the data to multiple devices, can determine location context for the wireless devices, and can perform other suitable functions over multiple networks. In this manner, wireless content switch 102 is used to support the provision of data and services to wireless devices in a manner that does not require the data on content servers 104A and 104B to be specifically configured for use by wireless devices.

FIGURE 2 is a diagram of a system 200 for providing service management functionality in accordance with an exemplary embodiment of the present invention. System 200 allows remote devices such as personal digital assistants, WAP-enabled phones, laptops, and other wireline or wireless devices to monitor data packets to determine whether data packets have been delivered, the bandwidth realized for the device, the operational status of the device, and other suitable information. The managed (or monitored) device includes a thin client 204 and a status register system 212.

System 200 includes user device 202, which can be a PDA, a WAP-enabled cell phone, a text pager, a laptop, a general purpose processing platform, or other suitable devices. User

device 202 includes management thin client 204 and status register system 212, each of which can be implemented in hardware, software, or a suitable combination of hardware and software, and can be one or more software systems operating on user device 202. User device 202 can also include management system 206, where suitable, such that status data can be transmitted from a management thin client 204 operating on another user device 202 to a user device 202 being used by a system operator or other suitable persons.

Managed device 208 can include a cable modem, a digital subscriber line (DSL) interface, or other suitable components that provide continuous access to the Internet. Workstation 210 is coupled to managed device 208, such as through the Peripheral Component Interconnect (PCI) bus of workstation 210, and receives data through managed device 208.

Management thin client 204 monitors data packets received over communications medium 214 or 216 at user device 202 or managed device 208, such as by receiving packet data that identifies the size of each data packet, address data for each data packet, sequence data for each data packet, or other suitable data. Management thin client 204 then transmits management statistics data to one or more management system 206, such as realized bandwidth data, packet sequence completion data, missing packet data, or other suitable data. In one exemplary embodiment, management thin client 204 can be implemented as a stand-alone software application that is downloaded onto user device 202 or managed device 208 when user device 202 or managed device 208 interfaces with a server on which management system 206 is operating. Likewise, management thin client 204 can be stored in a data memory of user device 202 or managed device 208, can be implemented as functionality in a web browser for

user device 202, or can be other suitable software or hardware functionality.

Status register system 212 of user device 202 or managed device 208 can receive status data from one or more systems operating on user device 202 or managed device 208, such as buffer overflow status, system operability status, user access status, or other suitable status data. In one exemplary embodiment, status register system 212 can also perform status analysis of systems and components of user device 202 or managed device 208, such as by transmitting query data to each of the systems or components and determining whether response data is an expected response, by storing the response data, or by performing other suitable functions. Management thin client 204 can periodically extract status data from one or more predetermined registers of status register system 212 or other suitable data that can be used to diagnose user device 202 or managed device 208 so as to determine if systems or components of user device 202 or managed device 208 are misoperating, have failed, are being interfered with (such as through an attempt by an unauthorized third party to gain access to the user device 202 or managed device 208), or other suitable status data.

Communications medium 216 can be a landline communications medium such as a local area network, a wide area network, the public switched telephone network, the Internet, or other suitable predominantly land-based communications media. Communications medium 214 can be a wireless network, such as a paging message network, a cell phone network with data message capability, a wireless network where data is transmitted over a voice channel in conjunction with a modem, or other suitable wireless communications media.

Management system 206 can be implemented in hardware, software, or a suitable combination of hardware and software, and can be one or more software systems operating on a general purpose processing platform. Management systems 206 receives status messages from management thin client 204, and use the status messages to determine whether user device 202 or managed device 208 is receiving data packets, is missing data packets from a message, is receiving bandwidth service at a predetermined quality of service or reliability level, or other suitable information.

In one exemplary embodiment, management thin client 204 generates a User Datagram Protocol (UDP) data packet message when a data packet is received in suitable data transmission protocol format, such as a UDP format, a transmission control protocol/Internet protocol (TCP/IP) format, or other suitable protocol formats. The data contained in the UDP receipt packet can include Signaling Network Management Protocol (SNMP) format data or other suitable management format data that is transmitted to management system 206, which receives the receipt packet(s) and determine whether a receipt packet has been received for all packets transmitted to user device 202 or managed device 208 for a given message. If one or more of the packets has not been received, management system 206 can then retransmit the missing data packet, perform troubleshooting, transmit control data to user device 202 or managed device 208, transmit control data to the transmission point to cause the missing data packet to be retransmitted, or perform other suitable functions.

Likewise, management thin client 204 can receive a control data message from management system 206 prior to the transmission of two or more data packets that identifies the numbering sequence of data packets, such that management thin

client 204 can transmit a suitable data message after all packets have been received indicating completion or failure of completion of the data transmission. Management thin client 204 can also be configured to check registers for predetermined data on user device 202 or managed device 208, such as registers that indicate that buffer overflow has occurred, registers containing data transmission rate data, system or component failure registers, or other suitable registers. Management thin client 204 can further transmit predetermined error or warning messages to management system 206 when predetermined data is received from user device 202 or managed device 208.

In operation, system 200 provides management functionality to allow devices that are typically not monitored for management statistics to be monitored in conjunction with provision of wireless services. System 200 allows message delivery statistics, bandwidth realization statistics, device monitoring, and other suitable functions to be provided for support of wireline and wireless devices. Unlike the SNMP network management standard, which typically requires the generation of agents to query network architecture devices such as switches and routers, system 200 provides for active and flexible management messages to be sent from user devices 202. In this manner, the normally server-based management functionality, which requires generating agents or messages, polling devices and systems, and performing other functions, can be distributed amongst a plurality of user devices 202. System 200 also allows user devices 202 or managed device 208 to actively process management data when they are on, such that an absence of management data can indicate the absence of a user device 202

or managed device 208 functioning, such as when a wireless device or DSL interface is turned off or is out of range.

FIGURE 3 is a diagram of a system 300 for providing transport module functionality in accordance with an exemplary embodiment of the present invention. System 300 includes transport module 120 and address management system 302, multicast system 304, location context system 306, transport reliability system 308, quality of service system 310, policy management system 312, and escalation and duplication system 314, each of which can be implemented in hardware, software, or a suitable combination of hardware and software, and which can be one or more software systems operating on a general purpose server platform.

Address management system 302 provides addressing, address management, and translation capability for diverse wireless and wireline networks, such that multiple devices over multiple networks can be supported through transport module 120. Address management system 302 allows wireless networks that use addressing schemes that are different on a network basis, using an address translation and assignment function. The address data for each user can be tracked, such as a most recent address and other historical addresses and other suitable data. Address management system 302 can also analyze incoming messages from devices to determine their current address for communication and other suitable uses.

Multicast system 304 receives multicast setup data from incoming data messages from wireless devices, and configures a multicast environment in connection with access adapter 118. The setup data can also be pre-configured as part of the user information. In one exemplary embodiment,

multicast system 304 receives a request for multicast functionality such as whiteboard functionality, chat room functionality, or other suitable functionality from a general purpose server platform or a wireless device, and determines the identities of other wireless devices with which to generate the group environment. For example, in a field service environment, field personnel may request assistance in resolving a problem in a group environment where a class of service personnel that work in that service area using different or similar devices will be contacted through multicast system 304. Likewise, multicast system 304 can be used to set up communications between two users, from two or more users to a single user, from a group of users to a different group of users, from a single user to any available user (such as for an emergency signal), or from a user or other system to all available users. The multicast system provides time synchronization of arriving data for correct sequencing.

Location context system 306 allows data pertaining to the physical location of a wireless device to be used to assist with provision of data or transmission of messages to wireless device operators. In one exemplary embodiment, location context system 306 can determine if a wireless device operator is physically located within a predetermined area, so as to notify the operator of a situation in which assistance may be required so the operator can travel to the location. Likewise, location context system 306 can determine whether an operator is in a physical location that would allow predetermined information to be of value, such as weather information, traffic information, routing emergency personnel to a location where they are needed, or other suitable information.

Transport reliability system 308 allows data packets sent to wireless devices to be monitored to determine whether all of the data packets for a data message have been received. In one exemplary embodiment, transport reliability system 308 interfaces with a web browser, a management thin client, or other suitable software applications so as to specify the size or other characteristics of a data message, and receives confirmation data packets from the browser or management thin client application and confirm receipt of the entire message. Transport reliability system 308 can also prompt a user to affirmatively indicate, such as through selection of an onscreen control, that a message has been received, that the user is available, or other suitable functionality.

Quality of service system 312 is used to allocate priority of content among users, such as to support organizational policies or other objectives. In one exemplary embodiment, messages to management or officers of the corporation can be given priority, such as when the management or officers are in transit and require data in order to make decisions that effect the enterprise. Likewise, quality of service system 312 can be used to provide greater bandwidth on a temporary basis, such as between users that are engaging in an interactive session with other users, users that are requesting specific information from predetermined data sources, or other suitable levels of quality of service. In another exemplary embodiment, quality of service system 312 can detect when a user is in a background mode, such that administrative data messages or other suitable non-urgent data can be transmitted to the user as wireless transmission bandwidth becomes available. Quality of service system 312 can also manage

quality of service in accordance with Realtime Transport Protocol (RTP), the Real Time Conferencing Protocol (RTCP), the ITU-T Recommendation 1.350 provisions, and other standardized measures for monitoring and controlling quality of service.

Policy management system 312 applies organization policy rules for allocation of data transmission bandwidth to users and applications. In one exemplary embodiment, policy management system 312 receives ranking data for one or more categories for each user and application that identifies whether that user or application is to be given transmission priority over other users or applications. In this manner, a request for bandwidth can be processed by comparing ranking data and allocating bandwidth according to predetermined rules, such as by giving certain rankings 100 percent of required bandwidth before allocating remaining bandwidth to other rankings, by allocating bandwidth based on predetermined ratios as a function of ranking, or other suitable rules.

Escalation and duplication system 314 allows the transmission of data messages to be escalated until an affirmative response has been received from one or more operators of wireless devices. In one exemplary embodiment, escalation and duplication system 314 can attempt to locate a user through a sequence of wireless devices, such as a cell phone, a personal digital assistant, a pager, an Internet appliance, or other devices. Likewise, escalation and duplication system 314 can send messages to a user at a landline location, such as a personal computer operating a web browser, a telephone at a residence or business, or other suitable locations. Escalation and duplication system 314 can also escalate to classes of users, such as to locate

colleagues of the person that is being contacted that perform similar functions, the manager of the person with whom contact is required, a class of persons with whom contact with any single person would be suitable, or other suitable forms of escalation.

System 300 provides transport module functionality to support data transmission in a diverse wireless environment. In addition to providing functionality for addressing and otherwise transporting preformatted data messages received from access adapter 118 to a plurality of users of multiple kinds of wireless devices, system 300 provides additional functionality that allows the users of wireless devices to perform multicast functions, provide location context functionality for such users, manage transport reliability, manage quality of service, and manage the escalation of data messages, and dynamically provides address management capabilities so that users can be contacted depending on the type of device being used by the user, their current location, and other suitable functions.

FIGURE 4 is a diagram of a system 400 for providing access adapter functionality in accordance with an exemplary embodiment of the present invention. System 400 includes access adapter 118 and web browser system 402, message context system 404, device context system 406, message intermediate format system 408, and application and user view system 410, each of which can be implemented in hardware, software, or a suitable combination of hardware and software, which can be one or more software systems operating on a general purpose server platform.

Web browser system 402 includes one or more web browsers configured for use with one or more corresponding wireless communications devices, such as WAP-enabled cell phones,

PDAs, pagers, or other suitable wireless devices. Web browser system 402 receives device identification data from transport module 120 and selects a suitable web browser for use on that platform. The web browser provided by web browser system 402 can further facilitate functionality of system 300, such as transport reliability functionality, escalation and duplication system 314 functionality, multicast system 304 functionality, or other suitable functionality.

In one exemplary embodiment, the web browser is a software application for the device running in the native system programming environment. In this exemplary embodiment, the web browser can include a mechanism to load different DTDs to support the vocabulary data that is specific to the content. The web browser can also parse a suitable data stream that is represented in a suitable format, such as an XML format. The web browser in this exemplary embodiment can parse WML tags, which is an XML DTD, and display them in the format specified by the WAP forum. The web browser can select the device-supported display characteristics for each tag that is specified in the WML.

In another exemplary embodiment, the web browser can provide functionality for reviewing documents that are available in suitable web browser-accessible formats. Examples of such formats include: (1) scripting and execution functionality to allow XML documents to invoke native system commands; (2) source display functionality; (3) hypertext transfer protocol (HTTP) support functionality; (4) document view functionality to allow the viewer to go forward and backwards from a current position; (5) functionality to allow the user to stop and resume downloading of information from the Internet or a content server; (6) functionality to allow

the user to request information from the Internet or a content server; (7) functionality to allow the reception of information from the Internet or a content server in the channel definition format (CDF) DTD and to generate user audio or visual alarms, to the extent such alarms are supported by the device; (8) functionality to add new XML based vocabularies; (9) functionality to provide data operations such as load, save, delete, and other suitable operations; (10) functionality to provide activation and deactivation of the services over the transport, and other suitable functions.

Message context system 404 provides message context functionality for data messages received from a content server, wireless device, or other suitable systems or apparatuses. In one exemplary embodiment, the message context functionality is equivalent to the DTD data provided for *.XML data. If DTD data is not provided with the message data, then default DTD data can be imposed on the message data. Message context system 404 can also store message context data after an initial message is received, such as for subsequent use from the server or from the operator of the wireless device.

Device context system 406 stores device data for a plurality of wireless devices. In one exemplary embodiment, device context system 406 stores device context data for different brands and functionality of cell phones, pagers, PDAs, laptops, or other suitable devices. Device context system 406 and message context system 404 can also interface with multicast system 304 to configure data for transmission to multiple concurrent devices.

Message intermediate format system 408 provides intermediate message context functionality, such as when DTD

data for an incoming data message has not been defined. Message intermediate format system 408 can also be used to fit incoming data messages, such as *.XML data, to a predetermined format.

Application and user view system 410 stores personalization data for use by individual users of wireless devices. In one exemplary embodiment, a user or organization may set up their wireless device for predetermined display features, such as where a company wishes to have a uniform display provided on different devices so as to facilitate training and to minimize differences in displays generated on different devices. Application and user view system 410 also allows users to interactively modify their display, so as to allow personalization of the user display default data. The user display default data can also be stored as a function of the application and user view system 410, or the display default data can be transmitted for storage locally such that the display default data is received at application and user view system 410 the next time the user accesses application and user view system 410.

In operation, system 400 provides message data processing functionality that allows multiple wireless devices to be supported for interfacing with a wireless content switch. System 400 allows message context and device context to be established for each set of data and user, such that the message data transmitted to each user's wireless device is in a predetermined format that allows the message data to be formatted for display on each user's wireless device.

FIGURE 5 is a flowchart of a method 500 for allowing a user to receive information through a wireless device in accordance with an exemplary embodiment of the present

invention. Method 500 begins at 502 where a user enters an address such as uniform resource locator (URL) data through a web browser system. The user can use an application or a web browser provided by web browser system 402, the Internet Explorer web browser, the Netscape web browser, a web browser provided with a WAP-enabled cell phone, or other suitable applications or web browsers. The address data is carried over the wireless communications media utilized by the wireless device until it reaches the web server or other device that the address data is associated with. The method then proceeds to 504.

At 504, the interface to the application, such as the common gateway interface, is invoked. When the request arrives at the application or web server, the server uses a standardized interface such as the common gateway interface to connect to the content switch. Other suitable interfaces can likewise be used. The method then proceeds to 506.

At 506, the device context is identified and stored in a data memory or other suitable locations. The method then proceeds to 508 where the wireless content switch collects the device capability and type information from the header such as an HTTP header and stores it in the device context database for the user session. If the user session is not available, a new user session is created. The wireless content switch can further process the request according to one of the following exemplary processes. The method then proceeds to 510 where the wireless content switch forwards the request to the file system or to the target content server for processing, validation, and response generation. If the request is an interactive transaction, then the access adapter can transfer the request to the content adapter, which in turn takes the previously generated application

message context information and converts the request into *.XML or other suitable standardized format net-based message data, in accordance with one or more rules defined in the application vocabulary data. Any missing information can also be supplied to fill in the required mandatory fields in the message. If permitted by the message protocol, such information can also include default areas of parameters. After the message data is assembled the content adapter forwards the message data to the content server. After a response is generated, the method proceeds 512.

At 512, the syntax rules and data are applied to the message data. The content adapter can validate the response coming from the file server or content server using the applicable application vocabulary data. If the message is valid, the content adapter can generate the application message context if necessary, and store it for an arbitrary time in the recession repository. The method then proceeds to 514. If it is determined at 514 that this is a first time response, the method proceeds to 516 where the message response context is stored in a data memory or other suitable locations. The method then proceeds to 518 where a session is created, and the method then proceeds to 520. If it is determined at 514 that this is not a first time response, the method proceeds directly to 520.

At 520, location context is created. The method then proceeds to 522 where application styling is applied. In one exemplary embodiment, the application message style sheet can include extensible style sheet (XSL) language format data, which allows the automatic transformation of XML based data into HTML and other presentation formats, such that the presentation format can vary from the underlying data structure.

The method then proceeds to 524 where a user preference style sheet is applied. The user preference style sheet can be a user selectable style sheet, a corporate use style preference, or other suitable user preference. The method then proceeds to 526.

At 526, the user's preferences for display and content are applied to the message data, which is then transmitted to the user by addressing through a suitable wireless data network. The method then proceeds to 528 where device styling is applied. At 530, the network protocol is adopted, such as to transmit the message to a wireless device in a network protocol. The method then proceeds to 532 where the response is sent to the user.

In operation, method 500 is used to provide message data to one or more wireless devices in response to requests from one or more users. Method 500 allows data to be provided from a single source, such that the data does not be to be preconfigured for use by certain wireless devices in particular, or by wireless devices in particular. Method 500 can also be used to provide data to full functioned web browser systems operating on general purpose processing systems.

FIGURE 6 is a flowchart of a method 600 for providing information push data in accordance with an exemplary embodiment of the present invention. Method 600 allows information to be transmitted to users without an initial solicitation from the user, such as in response to a notification setup architecture.

Method 600 begins at 602 where data for the information push in the content server is prepared. For example, the information push criteria can include an hierarchical escalation of devices to be notified, an hierarchical

destination of devices, such as a cell phone, a wireless pager, a personal digital assistant, or other suitable devices, or other suitable information push criteria. The method then proceeds to 604.

At 604, the device context and styling data is loaded from a user profile in a data memory or other suitable locations. For example, the device context can include XML DTD definitions or other suitable device context data. Likewise, the device style sheet can include XSL device style data or other suitable style sheet data. The method then proceeds to 606.

At 606, a request is processed to generate notification data. The request can include a request that a user be notified when predetermined events occur, such as misoperation of a piece of equipment, an attempted "break in" of the equipment such as "hacking" into a web server or router, a request from a customer for assistance, an emergency signal, or other suitable data requests. The method then proceeds to 608.

At 608, the syntax of the request is verified, such as by comparing the data to XML DTD data or rules or other suitable syntax requirements. The method then proceeds to 610 where an application message style sheet is applied to the data, such as an XSL style sheet or other suitable application message style sheets. The method then proceeds to 612.

At 612, user preference style sheets are applied if present. A default user preference style sheet can also be applied based upon the type of device, transmission bandwidth, or other suitable data or parameters. The method then proceeds to 614 where the user's preferences for displaying content are then applied if present. The user's

preferences can be stored locally, at the user's device, or in other suitable locations. The method then proceeds to 616.

At 616, it is determined whether confirmation data has been received. Confirmation data can be generated in response to a user selectable control, such as in order to view the message, or to make the message leave the user's screen. If confirmation data is received, the method proceeds to 618 and terminates. Otherwise, the method proceeds to 620.

At 620, it is determined whether there is another device available to escalate the data push for that user. In one exemplary embodiment, the user can identify two or more devices through which the user should attempt to be contacted. For example, the user may have a WAP-enabled cell phone, a PDA, a pager, a general purpose processing platform at work, and a general purpose processing platform at home, each of which may be potential locations where the user may be located. If it is determined at 620 that one of these other devices is determined to be available and an attempt to contact the user at that device has not been made, the method proceeds to 622 where the next device data is received. The method then returns to 606.

If it is determined that no other devices are available at 620, the method proceeds to 624 where it is determined whether other users are available. In one exemplary embodiment, other users such as service personnel, company corporate personnel, or other suitable users can be identified that can respond to predetermined notifications. If it is determined at 624 that other users are available, the method proceeds to 626 where the next user data is retrieved. The method then returns to 606. Otherwise, the

method proceeds to 628 where notification data is generated, such as a global notification to all users of the need to locate a particular person, an error record indicting that a particular notification event was not responded to or other suitable notification data.

In operation, method 600 allows information to be pushed to one or more users, and further provides for escalation to other devices or other users in the event no confirmation of the information push is received. Method 600 thus allows wireless devices to be improved in reliability such that delivery of a message to an operator can be assured if an operator is present anywhere in the organization.

FIGURE 7 is a diagram of a system 700 for providing data in a wireless environment in accordance with an exemplary embodiment of the present invention. System 700 provides an exemplary embodiment of content adapter 116 and access adapter 118, and includes browser 702 that provides additional functionality. Browser 702 can be implemented in hardware, software, or a suitable combination of hardware and software, and can be one or more software systems that operate on a wireless platform. In one exemplary embodiment, browser 702 is downloaded onto the wireless platform, such as over the wireless communications link, and can also or alternatively be installed by a hot link connection between the wireless device and a general purpose computing platform or data storage device, can be preinstalled, or other suitable delivery mechanisms for installing browser 702 on a wireless device can be used.

Browser 702 includes information request system 704, information parser interface 706, information parser 708, and information display 710, each of which can be implemented in hardware, software, or a suitable combination of hardware and

software and which can be software systems operating on the PalmPilot operating system platform. Information request system 704 can open a user datagram protocol socket so as to request a WML data file or other suitable data file that includes a WML deck or other suitable data structure. Information parser interface 706 takes the WML deck and closes the socket and sends the WML deck to information parser 708. Information parser 708 parses the WML deck into fields and determines the display data for each tag. Information display 710 displays the WML deck on a PDA screen.

Access adapter 118 includes message conversion system 712, message field system 720, and browser interface 718, each of which can be implemented in hardware, software, or a suitable combination of hardware and software and which can be one or more software systems operating on a general purpose server platform.

Message field system 720 prepares message fields for processing by the content server. Socket system 722 creates a socket which listens for the data requests from browser 702. Connection system 724 creates and maintains a connection over TCP with the content adapter, such as a virtual server operating on the content adapter. Verification system 726 receives messages from the virtual server or other suitable system and verifies the message against predetermined vocabulary data. Socket system 722 performs the software initialization process for access adapter 118 to communicate with browser 702. Connection system 724 performs the software initialization process for access adapter 118 to communicate with the content adapter 116. Information request system 704 opens a UDP socket to communicate with the underlying transport network

implementation, such as a wireless data communications media, a wireless voice communications media in conjunction with a modem, an infrared communications medium, a Blue Tooth wireless system, other suitable media, or a suitable combination of such media. This process can be performed in a manner so as to be transparent to the end user based on the implementation.

Verification system 726 checks the message data for validity and consistency against the applicable WML vocabulary data. If the message is valid, then access adapter 118 applies the previous message context if applicable. In one exemplary embodiment, a default message context can be used if no previous context is available. The access adapter can also store the device context for use in generating the response the next time the user accesses that data source with the wireless device.

Message conversion system 712 includes context system 714 and application system 716. Message conversion system 712 can convert the message data received from the content server into WML or another suitable format. Context system 714 can identify the message data and saves the context including the header for subsequent use with that content server, wireless device, or other suitable purposes. Application system 716 applies the application style sheet and then the WML style sheet.

Browser interface 718 can create the final output and forward it to the web server. Browser interface 718 can also take converted WML data or data in other suitable data formats and send it to the WML browser or other suitable browsers. Browser interface 718 can further close the socket if needed.

Content adapter 116 includes server socket system 728 and server interface 730. Content adapter 116 operates as a virtual content server. Server socket system 728 creates a TCP socket, which waits for the request from the content server or from the access adapter 118. Server interface 730 sends a request to the content server and a response to access adapter 118. The messages do not need conversion in this exemplary embodiment. The access adapter 118 forwards the message to content adapter 116, which turns the message into a "request message." Content adapter 116 then communicates with the content server to get the response. When the content server provides response in a suitable format, such as a message written using XML vocabulary data and in accordance with other XML format rules, content adapter 116 forwards the response message data back to the access adapter 118.

Access adapter 118 acts on the response message by having context system 714, application system 716, and browser interface 718 prepares the message data to be send out to the web server by applying application-specific style sheet rules and data, user preferences rules and data, and device-specific style sheet rules and data in that order. Access adapter 118 also creates the application message context that is kept for an arbitrary time for use with any subsequent requests from that user.

In operation, system 700 provides an exemplary implementation of a wireless content switch, including exemplary software systems that provide exemplary content switch functionality. System 700 allows content servers to be queried to obtain data on the content server in response to request from users of wireless devices.

FIGURE 8 is a flowchart of a method 800 for implementing an information pull process in conjunction with a wireless content switch, in accordance with an exemplary embodiment of the present invention. Method 800 begins at 802 where address data, such as URL data, is entered through a web browser on a wireless device. The method then proceeds to 804 where an interface, such as a common gateway interface, is invoked. The method then proceeds to 806 where device context data is stored in a data memory or other suitable locations.

At 808, the request data is validated. The method then proceeds to 810 where it is determined whether a message template, such as DTD data or other suitable data, is required. If a message template is not required, the method proceeds to 814. Otherwise, the method proceeds to 812 where a message or other suitable message data is built based on the message template data, such as DTD data or other suitable data. The method then proceeds to 814.

At 814, the request message data is transmitted for delivery to the content server. The method then proceeds to 816 where response message data is generated by the content server in response to the request message data. The response message data is validated for translation using the message template, such as DTD data or other suitable data at 818, and the method proceeds to 820 where application styling data such as a styling information base or other suitable data is applied. The method then proceeds to 822.

At 822, user preference styling or other suitable data is applied. The method then proceeds to 824 where device styling data from the device context or other suitable data is applied. The method then proceeds to 826 where the

application message context is stored in a data memory or other suitable locations.

In operation, method 800 provides an exemplary embodiment of an information pull technique for a wireless content switch in which a content server responds to a request for information using the wireless content switch as middleware. Method 800 allows data to be provided to wireless devices, general purpose computing platforms connected to wireline communications media, or other suitable devices from a single data source, without having to perform web clipping or other manual setup of the data for a wireless environment.

FIGURE 9 is a flowchart of a method 900 for providing policy management functionality in accordance with an exemplary embodiment of the present invention using quality of service for a wireless environment. Method 900 allows the implementation of organizational policies for information access and related prioritization for management of the quality of service of data provided in a wireless environment.

Method 900 begins at 902 where data is received from a user device. In one exemplary embodiment, the data is data packets, which are monitored by a management thin client application, a web browser, or other suitable software systems. The method then proceeds to 904.

At 904, network context data is derived. In one exemplary embodiment, the network context data can include address and sequence data received in each of the data packets. The method then proceeds to 906. At 906, address data is isolated from the network context data. The method then proceeds to 908 where data is transmitted to a content server. The method then proceeds to 910.

At 910, a response including message data is received from the content server. The method then proceeds to 912 where user context and organization policy data are retrieved using application header data. The method then proceeds to 914 where the response data is labeled and tagged based upon the network context of the data and organizational policy. The method then proceeds to 916 where the information is transmitted to a transport module for transmission to the user.

In operation, method 900 allows data reliability, quality of service, and other suitable data to be monitored in a wireless environment. Method 900 can be implemented in conjunction with a management thin client, web browser, or other suitable systems that are resident on one or more wireless devices. In this manner, method 900 does not require the generation of agents, polling messages or other centrally generated messages, and instead uses a passive message generation technique wherein the centralized location receives messages from the distributed wireless environment and uses these messages for primary service management monitoring functions.

FIGURE 10 is a flowchart of a method 1000 for escalating messaging functions in accordance with an exemplary embodiment of the present invention. Method 1000 begins at 1002 where a service request is received. The service request can be a service request that is automatically generated from a piece of equipment, a service request from a customer, a service request from a dispatcher, or other suitable service request data. The method then proceeds to 1004. At 1004, a service request message is generated. The service request message can include one or more addresses for parties or wireless devices that are indicated as being

capable of responding to the service request. The method then proceeds to 1006 where it is determined whether an active response has been received. If an active response has been received, the method proceeds to 1008 and terminates. If no active response is received at 1006, indicating that no one has responded to the service request, the method proceeds to 1010 where escalation data is retrieved. The method then proceeds to 1012.

At 1012, it is determined whether the escalation data has been depleted. In one exemplary embodiment, if retrieval of the escalation data results in a null value, it is determined that escalation data has been depleted. If the escalation data has not been depleted, the method returns to 1004. Otherwise, the method proceeds to 1014 where error log data is generated that indicates that no response to the service request was obtained. The method then proceeds to 1016 where escalation data is reset. In this manner, the service request will continue to be generated until a response is received. The method then returns to 1004. Likewise, the method can terminate after 1016 if it is not necessary to have a continuous message until a response is received.

In operation, method 1000 provides a feedback mechanism that escalates messages until a response is obtained. Although a service request is shown in the exemplary embodiment of method 1000, other suitable data requests or data messages can be transmitted, wherein the failure of the operator to respond results in escalation of the service request or other data request.

FIGURE 11 is a flowchart of a method 1100 for dynamic addressing and address management in accordance with an exemplary embodiment of the present invention. Method 1100

begins at 1102 where a service request is received. The method then proceeds to 1104 where the address and mapping data for the session are determined from the message content. For example, a user identification table may be created that includes user device data, user device address data, user identification, user software applications, and other suitable data. The identification of the user can be determined from predetermined fields, a best match with all fields, or other suitable methods. The method then proceeds to 1106.

At 1106, a wireless network address is associated to a local address for the application. In one exemplary embodiment, certain addresses can be allocated greater bandwidth than other addresses, such that an application is assigned to an address that will support the application's operation. Likewise, the port may be assigned to the application based upon the user identification. The method then proceeds to 1108.

At 1108, priority is set based upon the user and the application. This priority can include priority for processing data for transmission to the user and for processing data received from the user, such as at a wireless content switch. Quality of service parameters may be specified in accordance with an existing service level agreement with a wireless carrier.

In operation, method 1100 allows priority to be assigned to users based upon user identification, application, or other suitable application. Method 1100 also provides for dynamic address management and addressing, such that when a user accesses a wireless content switch, the device that the user is using and the address for the user can be updated in a dynamic addressing table. In this manner, in an

information push scenario or escalation scenario, the device being used by the user can be kept current, such that user can be readily identified.

FIGURE 12 is a flowchart of a method 1200 for controlling quality of service and providing reliable transport in a wireless environment in accordance with an exemplary embodiment of the present invention. Method 1200 begins at 1202 where transfer parameters are set based upon network, application and device data. In one exemplary embodiment, the available network bandwidth is surveyed to determine the amount of bandwidth that can be allocated to a given device. The number of other users, applications being operated by those users, and other suitable device data can also be reviewed to allocate network bandwidth. The method then proceeds to 1204 where data packets are transmitted to the wireless device.

At 1206, response data is received from the wireless device at a management server. The method then proceeds to 1208 where the response data at the server is mapped to data that has been transmitted. After the response data is mapped to the transmitted data, it is determined whether any of the data packets that were transmitted to the wireless device were missing at 1210. In one exemplary embodiment, the response will be mapped at the wireless device, such as by a thin client, web browser, or other suitable system that receives data defining the number of packets, predetermined packet sequence fields, and other suitable data and rules. Alternatively, the response data can be mapped to the transmitted data at a centralized location, such as at a the wireless content switch in response to data messages generated by the wireless device, or by other suitable

functionality that transmits network management messages to a centralized location.

If it is determined at 1210 that packets are missing, the method proceeds to 1214 where the missing packets are retransmitted, such as by sending a request for the missing packets from the wireless device, transmitting suitable control data indicating which packets are being transmitted, or other suitable processes. If it is determined that no packets are missing at 1210, the method proceeds to 1216 where it is determined whether a change in network has occurred.

At 1216, if it is determined that a change in the network has occurred, such as certain operators of wireless devices leaving the service area, signing off, turning off applications, or otherwise freeing up bandwidth or decreasing the amount of bandwidth, the method proceeds to 1218 where the transfer rate is adjusted to accommodate the changes in the network. Otherwise, the method returns to 1204.

In operation, method 1200 is used to manage the reliability, quality of service, and reliability of transport for wireless data in a wireless environment. Method 1200 allows data packets to be tracked upon completion of delivery to a wireless device, such that devices having insufficient bandwidth can be identified. Likewise, data transfer rates can be modified to accommodate changes in the network, such as increasing or decreasing bandwidth capability, the presence of users having higher priority, or other suitable functionality.

Although exemplary embodiments of a system and method for live and simulcast auctions have been described in detail herein, those skilled in the art will also recognize that various substitutions and modifications can be made to the

systems and methods without departing from the scope and spirit of the appended claims.